TITLE:

MEASUREMENT OF ANISOTROPIC MAGNETIC SUSCEPTIBILITY ON TAILINGS CORES OBTAINED FROM THE ONTARIO RESEARCH FOUNDATION LYSIMETER EXPERIMENT

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ABSTRACT

Anisotropic magnetic susceptibility measurements are reported on 72 specimens taken from 5 cores removed from the ORF lysimeter tailings experiment. A Fast Fourier filter routine was developed to isolate only those components that are contributing to the anisotropic susceptibility. Foliation fabrics, recognised by a concentration of minimum susceptibility axes, and Q values less than 0.67, are mostly shallow dipping. Lineation fabrics are recognised by a concentration of maximum susceptibility axes, and Q values greater than 0.67. Cores 30 and 29 define relative northwesterly trending lineations, while cores 7, 26, and 32 have more south-westerly trending lineations. These lineations are similar to the trends of the alteration zone boundaries defined by bulk susceptibility measurements.

INTRODUCTION

In a previous study (Morris 1984) it was shown that magnetic susceptibility measurements on 40 cores obtained from the uranium tailings lysimeter experiment at the Ontario Research Foundation, could be used to identify three zones of differing chemical behaviour. An upper zone dominated by surface runoff is characterised by enhanced hematite and magnetite concentrations. An intermediate zone contained local regions of depleted oxide minerals which appear to define a dendritic drainage pattern. In the basal zone of the tailings pile oxide minerals were depleted over most of the tailings bed.

Using graphical techniques for the decomposition of multiple normal populations (Clarke 1977) it was possible to show that susceptibility measurements on the tailings distinguished two levels of alteration state. It is assumed that the "degree of alteration" suggested by the susceptibility values is a measure of the volume of fluid that has passed through any unit volume of tailings. That is, the more fluid passing through a zone, the more altered will be the magnetic oxides, and therefore the more reduced will be the susceptibility signal per unit tailings volume. From regional studies one can then construct maps of alteration levels for specific depths in the tailings. Regions of differing susceptibility level for any depth surface are taken as defining the flow region for that particular depth.

As an alternative (and supporting) approach to this mapping technique we report here the results of an investigation into the use of anisotropic susceptibility (AMS) measurements on tailings. In the AMS technique we investigate the bulk geometry of oxide particles in a specimen. Magnetite crystals exhibit the property of shape anisotropy. Magnetite forms crystals in the cubic system, hence a pure single crystal will always have the same magnetic susceptibility along all axes of the crystal. However magnetite may occur naturally as elongate multigrains, or as a string of aligned single grains. In each of these cases susceptibility along the elongate axis of the crystal(s) will be much greater than across the short axis. Hematite in contrast is a hexagonal mineral, which exhibits a crystalline anisotropy in the basal plane of the hematite rhombs.

Crystal alignment is closely related to the fluid transport pattern at the time of deposition, and to the effects of chemical redeposition. Therefore subsequent measurement of the magnetic fabric (AMS) of a specimen should give some information about the planar and linear fabric elements present in certain sections of the tailings.

METHODOLOGY

All measurements of magnetic susceptibility were made on a Sapphire Instruments S.I.-1 susceptibility bridge. For each measurement an integrating time constant of 4 seconds was used. Eight mesurements were obtained on each of the XY, YZ, and XZ planes of each specimen. Each set of eight measurements was processed by a Fast Fourier Transform algorithm to isolate the Sin2O components from all other components. (When rotating a specimen in any plane, any susceptibility anisotropy present in that plane must by definition exhibit a Sin2O variation). After correcting each of the three sets of eight measurements for each specimen, the orientation of the susceptibility axes of that specimen was calculated using a diagonalised matrix routine.

Commonly each specimen will contain more than one magnetic fabric element. And as the sum of two Sin waves is itself a Sin wave, whose phase is dependent upon the relative magnitudes and phases of the two contributing Sin waves, the susceptibility axes calculated for a single specimen are actually some vector combination of the axes present in the specimen. It is assumed that each specimen contains varying amounts of each susceptibility axis. The result is a spread of susceptibility axes from which the true axes must be derived. Unfortunately as yet no rigorous mathematical approach to this problem has been reported in the literature. Therefore for this report we have isolated the magnetic fabric (AMS) elements representative of each core by visually identifying the relationship between

concentrations of maximum (minimum) susceptibility axes, and great circle distributions of the intermediate, and minimum (maximum) susceptibilty axes. A lineation is identified by a grouping of the maximum susceptibility axes, while a foliation is defined by a grouping of minimum susceptibility axes. A number of statistics (see Appendix) based on ratios of the magnitudes of the susceptibility axes have been derived to differentiate lineation and foliation fabrics (in this instance we used a Q value at 0.67).

RESULTS

The fabric elements isolated in cores 7, 26, 29, 30 and 32 are listed in Table 1, and displayed in figures 1 to 5. The results of individual specimen measurements are listed in the Appendix. Only seventy-two specimens were available for analysis. Between submission of our letter of recommendation in February and awarding of the contract in July a number of the specimens were used by Dr. W. S. Fyfe's group for chemical studies.

All fabric directions are reported relative to the lysimeter perimeter; Line E is taken as trending due North.

Core 7 (figure 1) contains a very well defined shallow dipping foliation. Error in the concentration of the minimum susceptibility axes suggest this foliation may actually be shallower than as portrayed in figure 1a. The lineation plot shows two moderately well controlled great circles. However the susceptibility axes perpendicular to these great circles are a) not tightly clustered, and b) not all of the same axis; maxima, intermediate, and minimum susceptibility axes are mixed together. The lineation fabrics are therefore of questionable validity.

Core 26 (figure 2a) has two foliation planes. The shallow dipping plane is tightly defined by both the great circle and a concentration of susceptibility mimima. The steeply dipping plane is better defined by a concentration of susceptibility minima than by the great circle data. The shallowly inclined feature probably records deposition. The significanace of the steeply

inclined vector is unknown. Core 26 contains a single lineation that is carried by three of the four specimens with lineation fabrics (figure 2b).

Core 29 (figure 3a) also appears to have steeply and shallowly inclined foliation planes. Both are equally well defined. Although poorly constrained by the great circle data Core 29 appears to have but one lineation (figure 3b).

Core 30 (figure 4a) shows a loose concentration of mimimum susceptibility axes close to the centre of the stereonet; a sub-horizontal foliation is implied. Figure 4b shows that Core 30 contains a lineation fabric that is very closely aligned to that found in the adjacent Core 29.

Core 32 (figure 5a) like many of the other cores appears to have two foliation fabrics. In this example it is the more shallowly fabric that is less well controlled. The lineation fabrics in Core 32 are essentially defined by the great circle spreads, there is little, or no concentration of susceptibility maxima.

Figures 6 and 7 summarise respectively the foliation and lineation fabrics defined for each core in the previous figueres. Many of the foliation fabrics appear to be quite shallow; they are probably recording details of the geometry of the sub-horozontal layering in each core. There does not appear to be any systematic pattern to the sense of the dip direction. At the time the cores were collected there was no suggestion of performing

AMS measurements on the resulting specimens. Accordingly no attempt was made to obtain an accureate orientation of the cores. Hence the variability shown in the dips is probably the result of inaccuracies in core orientation. In future studies fully oriented cores will have to be obtained.

Even with the inaccuracies in core orientation the lineation data do show broad consistences. Around cores 29 and 30 the predominant lineation appears to be relatively northwest oriented. While around cores 7, 32, and 26 the lineation has a more northeast-southwesterly orientation. The orientation of these lineation fabrics closely approximates to the trends of the boundaries between the altered and unaltered tailings as derived by the bulk susceptibility data.

SUMMARY

This small survey has shown:-

a) that it is possible to use the anisotropic magnetic susceptibility technique to identify the presence of foliation planes and lineations in complexly deposited tailings.

b) that it is possible to use magnetic fabrics in conjunction with bulk magnetic susceptibility studies to obtain information on the migration of fluids in tailings.

For future studies it is recommended that:-

a) that all future studies be performed on fully oriented cores.

b) that some effort be expended in developing a technique for a mathematically exact decomposition of multiple fabrics.

REFERENCES

Clark, I., 1977

ROKE, A computer program for non-linear least-squares decomposition of mixtures of distributions.

Comlputers and Geosciences 3, p. 245-256.

Morris, W. A., 1984

Measurement of magnetic susceptibility on tailings cores: Report on cores obtained from the Ontario Research Foundation Lysimeter Experiment.

Contract Report to G. M. Ritcey, CANMET, 85p.

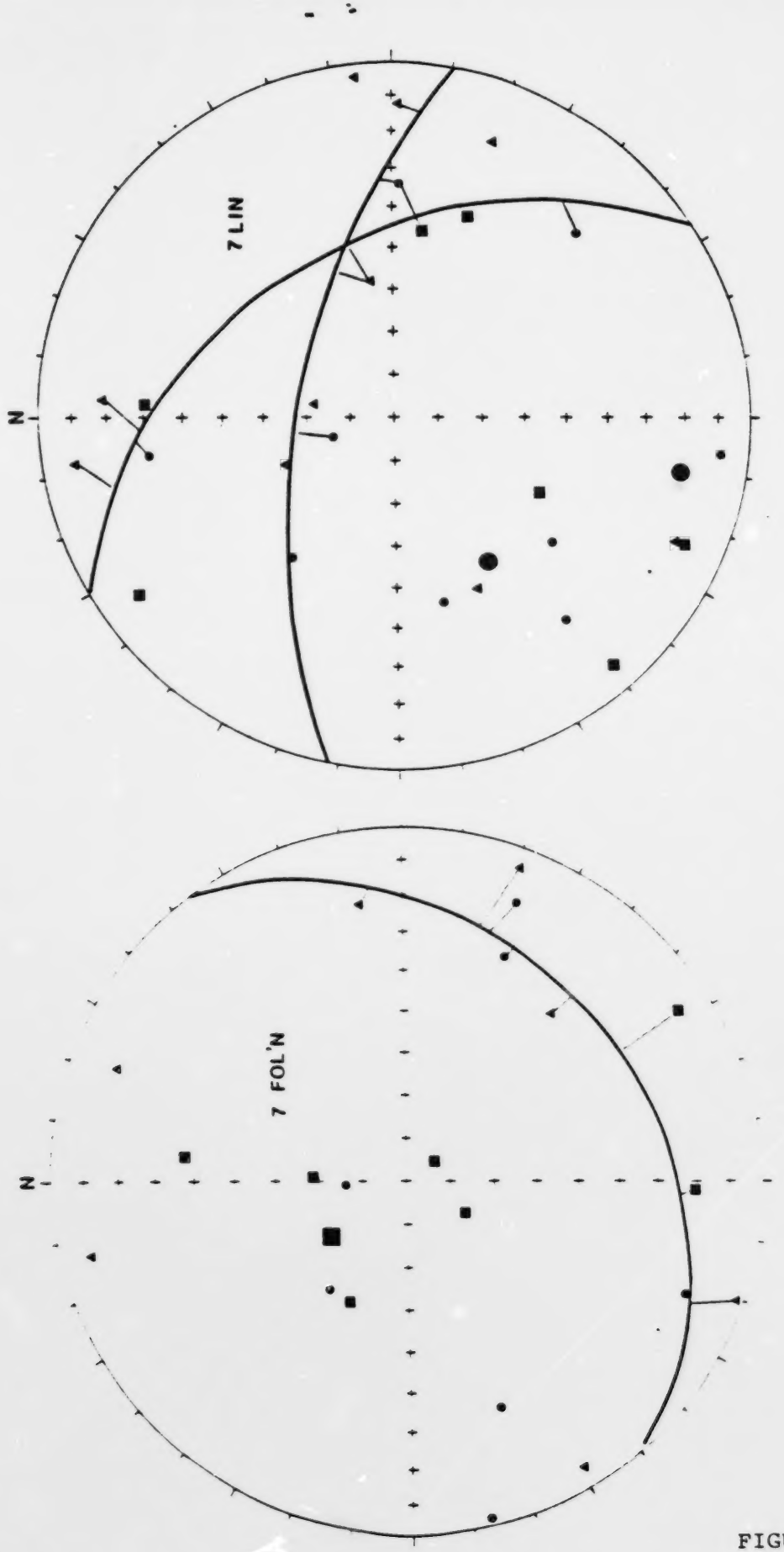
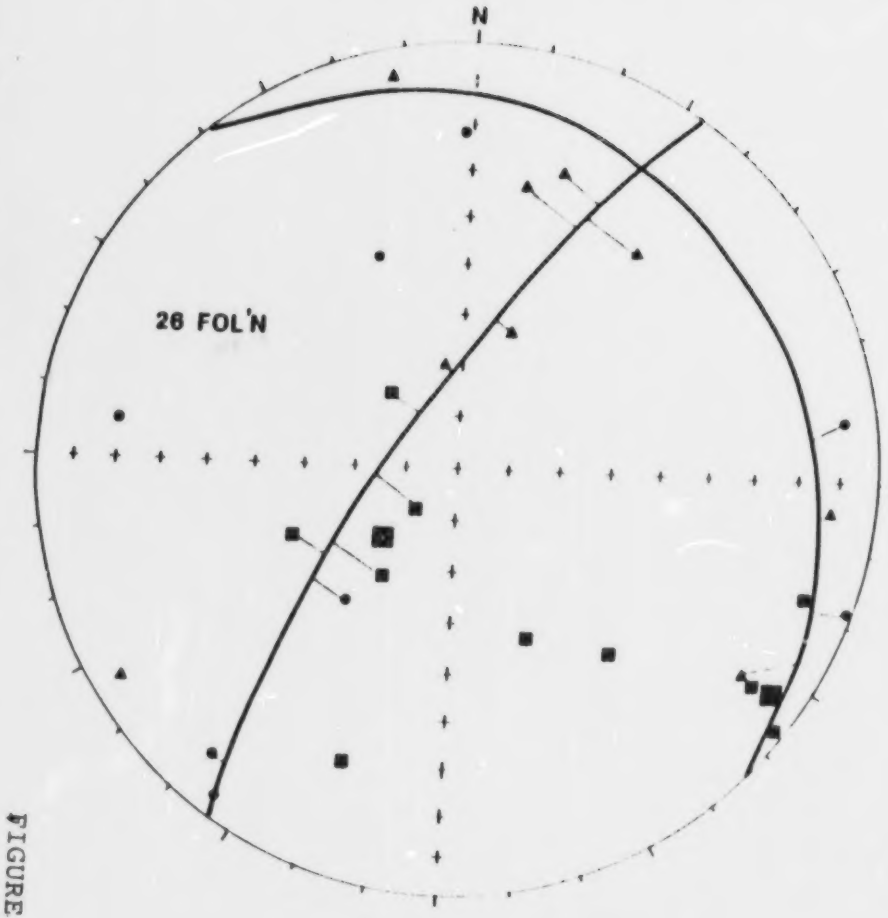


FIGURE 1



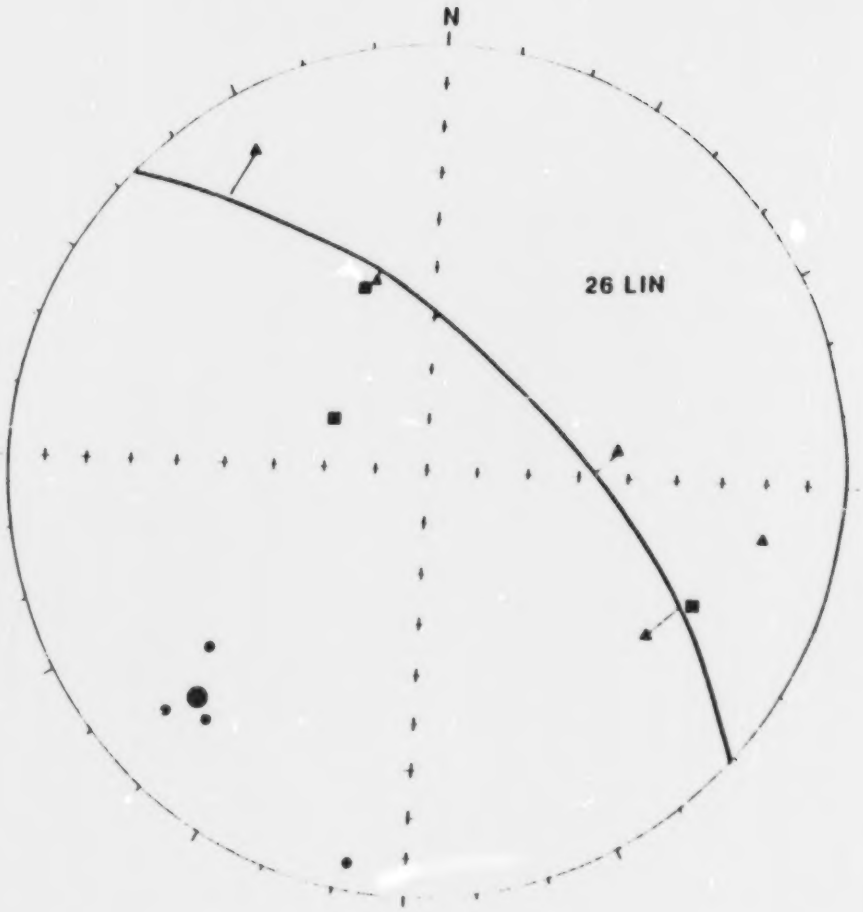


FIGURE 2

FIGURE 3

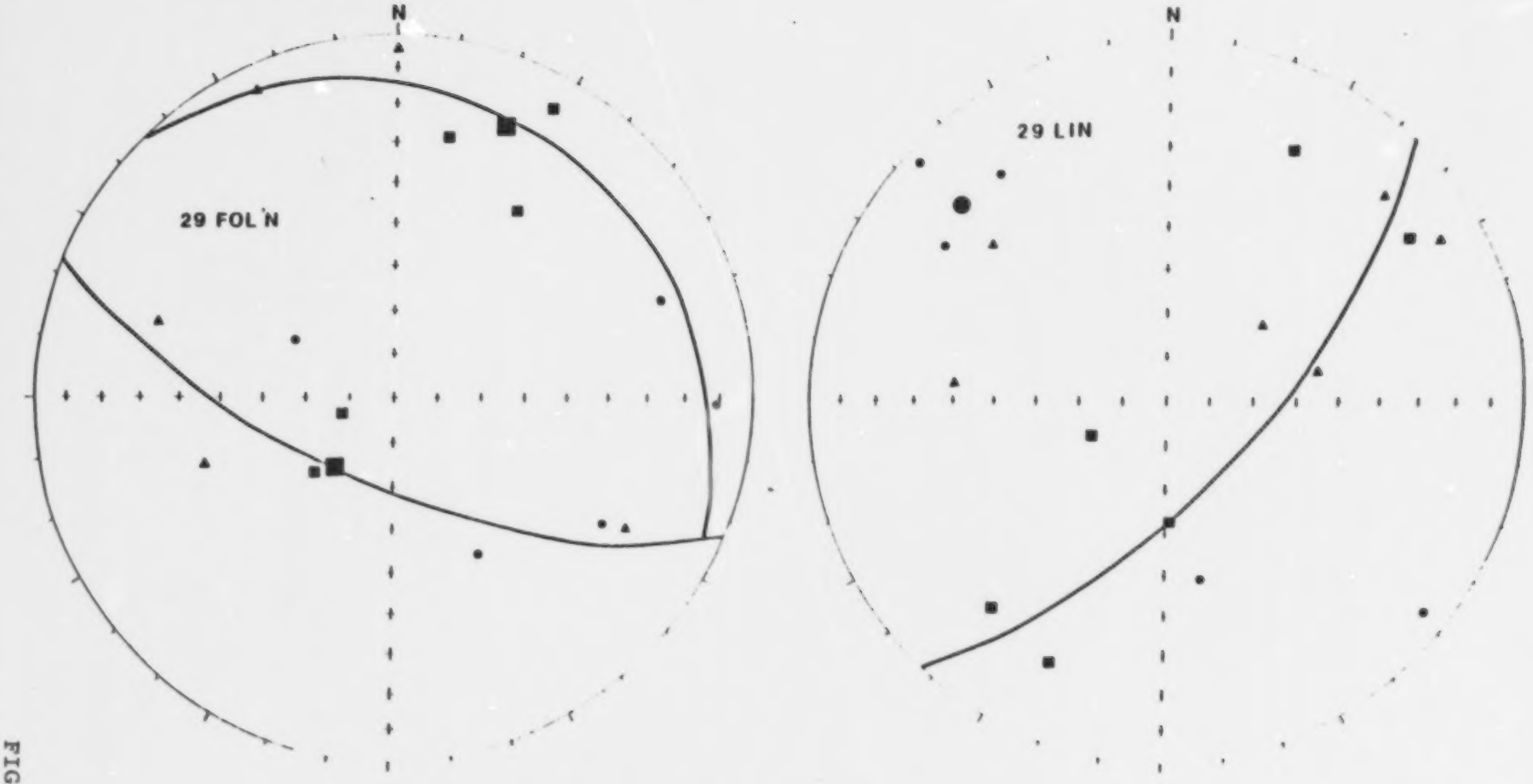


FIGURE 3

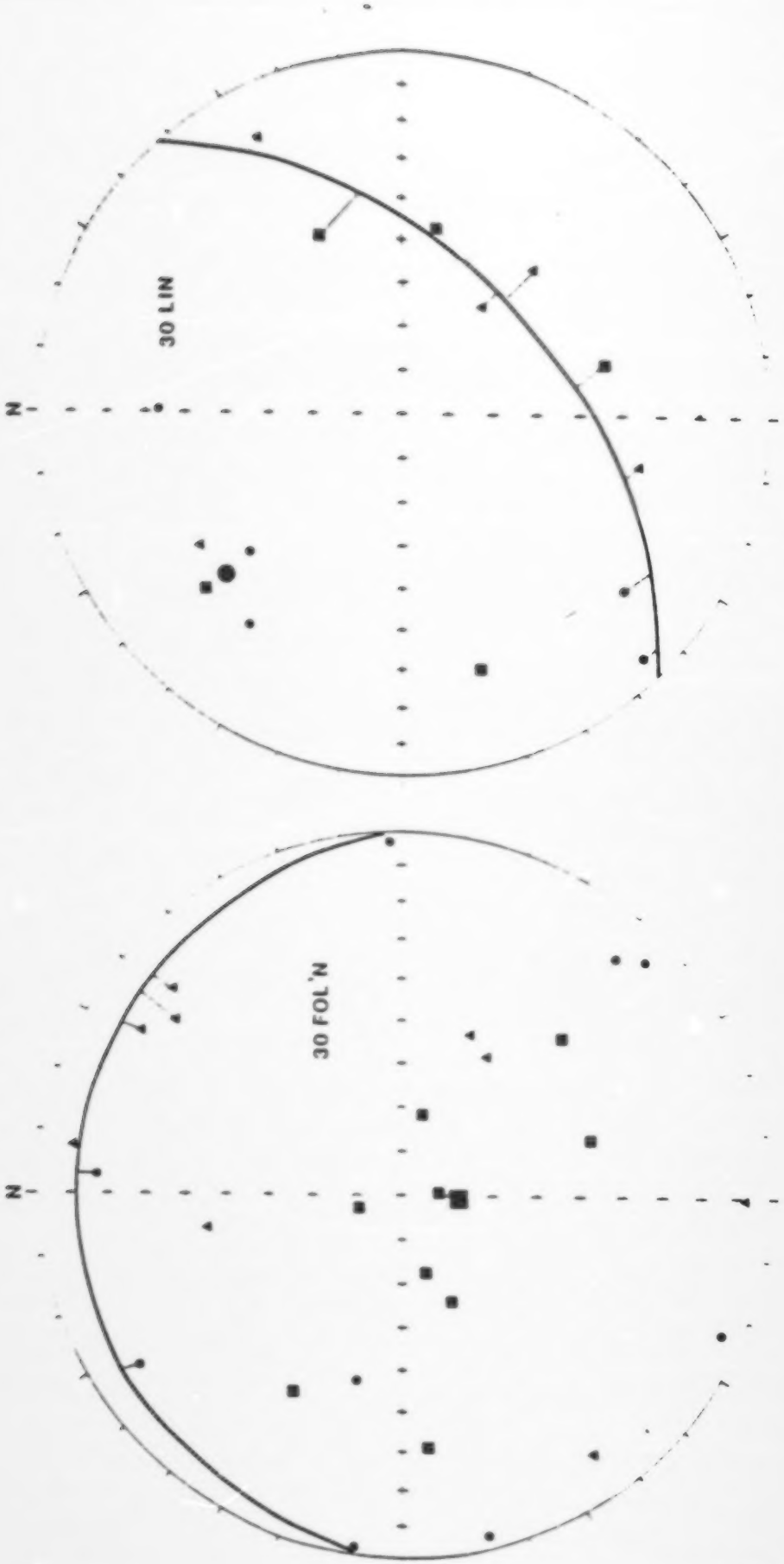
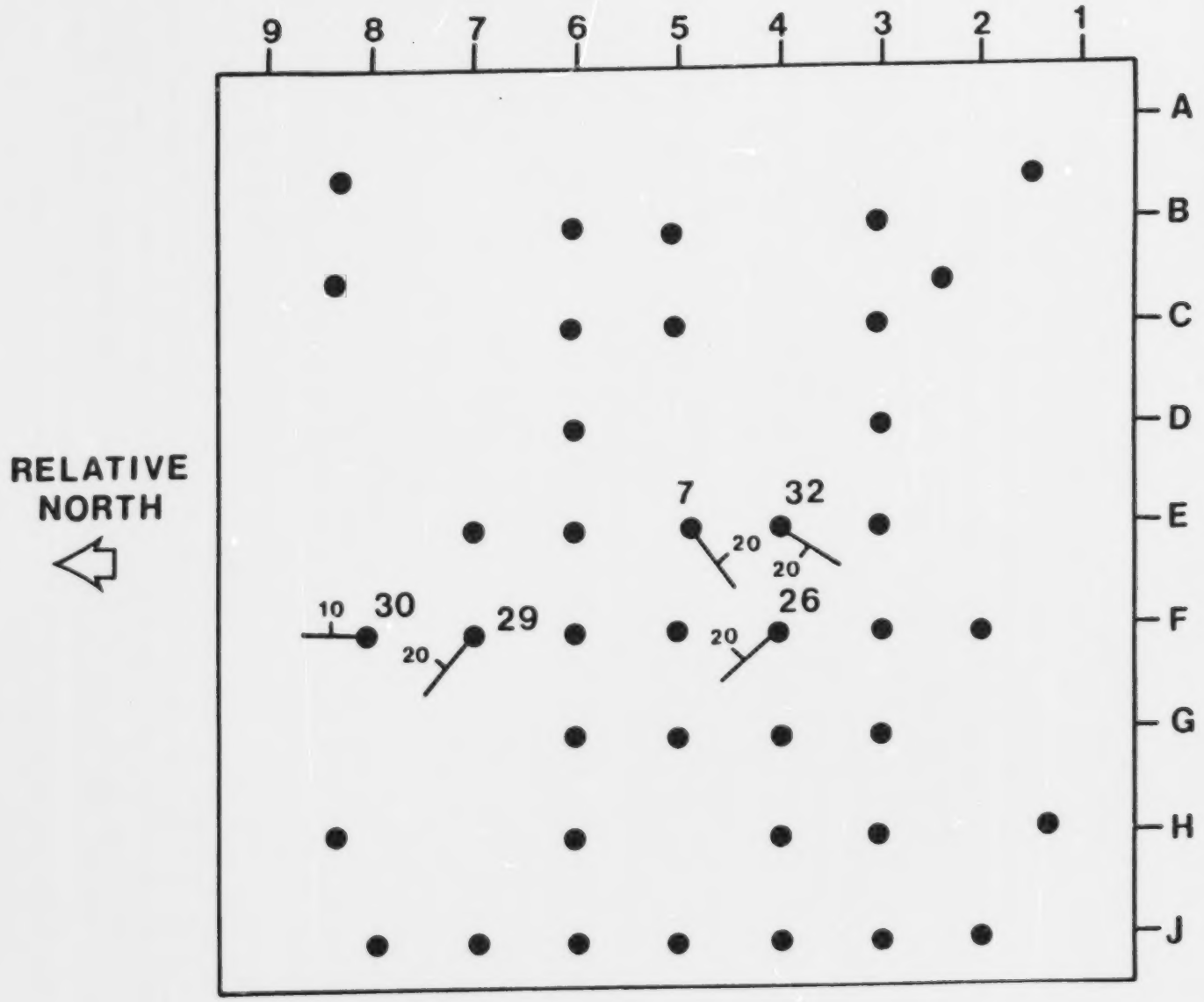


FIGURE 4

FIGURE 5



ORF LYSIMETER - FOLIATION

FIGURE 6

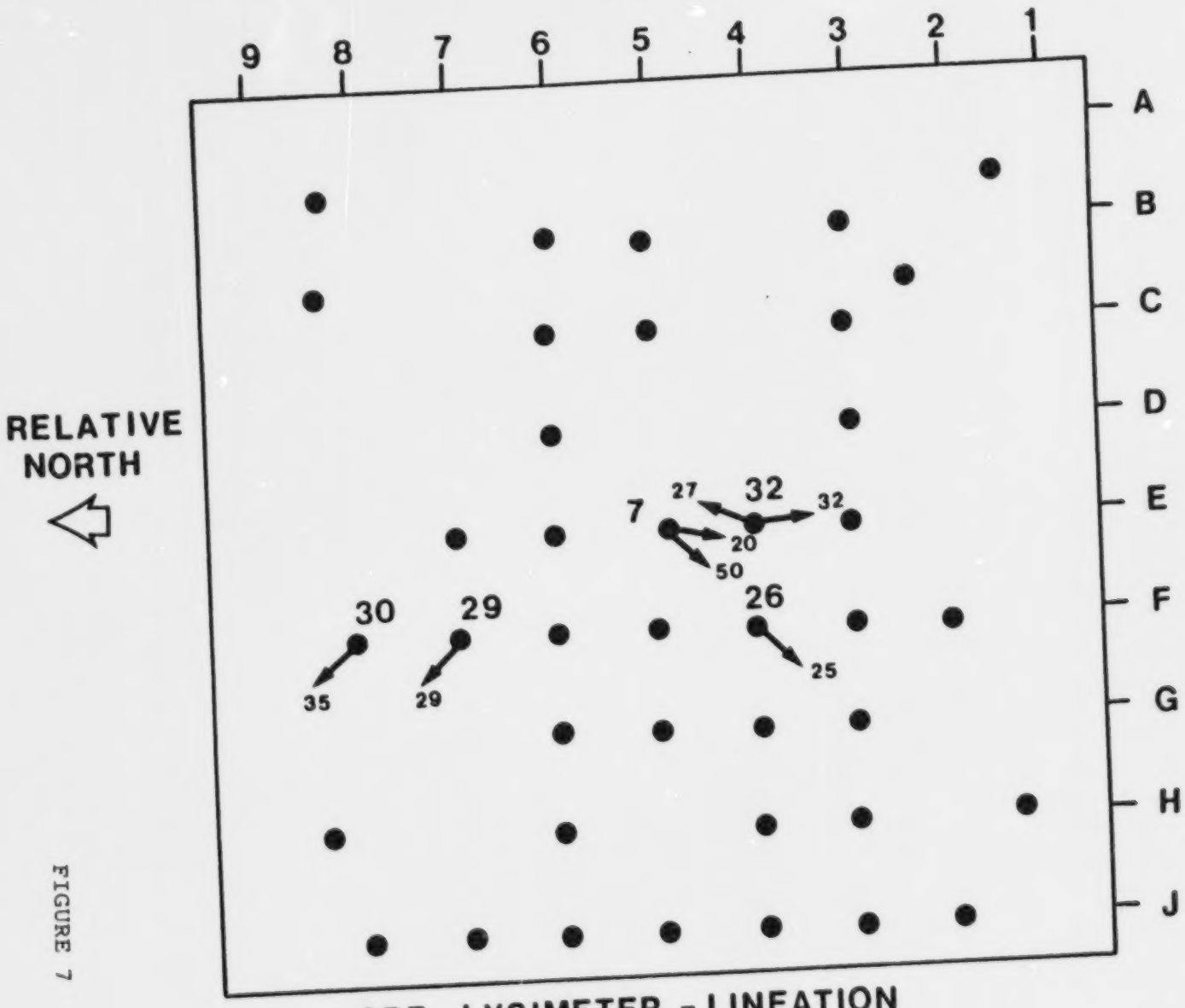


FIGURE 7

ORF LYSIMETER - LINEATION

TABLE 1

FABRICS DETERMINED IN CORES

	FOLIATION	LINEATION
CORE 7	20 to 143	20 to 192, 50 to 236
CORE 26	20 to 050, 80 to 305	25 to 224
CORE 29	20 to 040, 70 to 202	29 to 312
CORE 30	10 to 360	35 to 317
CORE 32	20 to 302, 50 to 340	27 to 024, 32 to 175

APPENDIX

SAMPLE STATISTICS

DEC, INC, MAG are respectively the declination, inclination and magnitude of the susceptibility vector.

MAG1, MAG2, MAG3 are respectively the minimum, intermediate and maximum susceptibility axes.

A/B = MAG3/Mag2

C/B = MAG1/MAG2

LIN = lineation = (MAG3-MAG2) / (MAG1*MAG2*MAG3)1/3

FOL = foliation = (MAG2-MAG1) / (MAG1xMAG2xMAG3)1/3

%ANIS = LIN + FOL

Q = (MAG3-MAG2) / (MAG3+MAG) / (2-MAG1)

$V = \text{Sin}^2 V$ = (MAG2-MAG1) / (MAG3-MAG1)

CORE 7

SAMPLE : 7 - 1

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
002.5	69.7	.261E-06	109.1	06.1	.370E-06	201.2	19.3	.468E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
1.795	.705	.32	.35	.67	.62	46.4

SAMPLE : 7 - 2

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
209.6	74.0	.109E-06	021.5	15.8	.198E-06	112.1	02.3	.276E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
2.530	.550	.59	.68	1.27	.61	47.0

SAMPLE : 7 - 3

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
007.0	37.2	.319E-06	131.5	36.8	.380E-06	249.1	31.8	.424E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
1.329	.839	.14	.19	.33	.53	49.6

SAMPLE : 7 - 4

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
150.9	81.1	.690E-07	347.7	08.5	.317E-06	257.4	02.5	.458E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
6.638	.218	.46	.81	1.27	.44	52.9

SAMPLE : 7 - 5

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
148.1	12.4	.242E-06	239.6	06.6	.358E-06	356.9	75.9	.437E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
1.809	.674	.21	.31	.51	.51	50.6

SAMPLE : 7 - 6

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
276.1	00.9	.515E-07	009.5	71.2	.167E-06	186.3	18.9	.363E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
7.061	.308	1.25	.73	1.98	.92	37.5

SAMPLE : 7 - 7

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
180.6	20.5	.225E-07	081.1	23.7	.838E-07	306.9	57.8	.101E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
4.476	.268	.27	.97	1.24	.24	62.4

SAMPLE : 7 - 8

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
352.3	12.3	.126E-07	245.1	53.5	.877E-07	090.5	33.8	.211E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
16.723	.144	2.28	1.39	3.67	.90	38.0

SAMPLE : 7 - 9

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
296.1	58.7	.496E-07	205.3	00.5	.774E-07	114.9	31.2	.944E-07

A/B	C/B	LIN	FOL	ANIS	Q	V
1.902	.641	1.33	2.17	3.50	.47	52.0

SAMPLE : 7 - 10

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
196.9	54.4	.240E-08	090.3	11.5	.561E-07	352.7	33.2	.186E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
77.738	.043	1.22	.50	1.73	1.10	32.7

SAMPLE : 7 - 11

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
110.8	38.8	.798E-08	004.9	19.4	.697E-07	254.7	45.1	.181E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
22.657	.114	3.48	1.93	5.41	.95	36.7

SAMPLE : 7 - 12

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
002.4	41.3	.383E-07	109.5	18.4	.709E-07	217.5	42.9	.219E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
5.727	.540	1.19	.26	1.46	1.39	25.1

SAMPLE : 7 - 13

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
229.4	09.2	.133E-06	336.4	61.6	.164E-06	134.8	26.7	.229E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
1.728	.810	.48	.23	.71	1.03	34.6

SAMPLE : 7 - 14

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
327.9	14.0	.478E-07	082.7	59.4	.708E-07	230.7	26.7	.182E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
3.800	.675	1.25	.26	1.51	1.41	24.5

SAMPLE : 7 - 15

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
098.9	45.7	.152E-06	203.9	14.1	.230E-06	306.4	40.8	.613E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
4.021	.661	1.33	.27	1.60	1.42	24.3

SAMPLE : 7 - 16

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
174.7	13.5	.706E-07	084.1	02.5	.232E-06	343.7	76.3	.603E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
8.541	.305	.45	.20	.65	1.07	33.4

SAMPLE : 7 - 17

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
265.9	42.9	.153E-06	137.1	34.0	.302E-06	025.9	28.1	.451E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
2.955	.506	.71	.71	1.41	.67	44.9

CORE 26

SAMPLE : 26 - 2

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
225.4	79.2	.445E-06	349.6	06.1	.730E-06	080.5	08.8	.924E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
2.075	.610	.47	.69	1.17	.51	50.5

SAMPLE : 26 - 3

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
154.7	55.1	.278E-06	016.4	27.5	.497E-06	275.7	19.7	.564E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
2.027	.560	.18	.60	.78	.27	61.0

SAMPLE : 26 - 4

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
115.2	28.6	.110E-06	343.2	50.9	.143E-06	219.5	24.2	.346E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
3.159	.767	.88	.15	1.03	1.51	22.1

SAMPLE : 26 - 5

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
213.6	64.6	.260E-06	084.9	12.8	.401E-06	359.8	21.5	.507E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
1.947	.648	.25	.34	.59	.54	49.2

SAMPLE : 26 - 6

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
198.4	29.0	.884E-07	017.93	61.0	.330E-06	108.3	00.2	.385E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
4.351	.268	.66	2.93	3.59	.20	64.6

SAMPLE : 26 - 7

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
124.3	16.0	.369E-08	347.5	68.6	.182E-06	218.3	13.9	.263E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
71.436	.020	.44	.98	1.42	.37	56.0

SAMPLE : 26 - 8

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
296.3	69.8	.111E-06	096.5	19.2	.250E-06	188.7	06.3	.606E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
5.451	.445	2.20	.86	3.05	1.12	32.0

SAMPLE : 26 - 9

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
139.1	43.1	.300E-07	237.7	09.1	.139E-06	337.1	45.5	.171E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
5.715	.216	.61	2.03	2.64	.26	61.3

SAMPLE : 26 - 10

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
109.1	13.2	.158E-06	011.2	30.2	.328E-06	219.8	56.4	.382E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
2.413	.483	.14	.43	.57	.28	60.5

SAMPLE : 26 - 11

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
320.4	70.1	.503E-07	124.9	19.3	.192E-06	216.6	05.5	.207E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
4.116	.262	.24	2.28	2.52	.10	72.0

SAMPLE : 26 - 12

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
339.9	50.6	.111E-06	123.6	33.6	.164E-06	226.2	18.2	.301E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
2.719	.675	25.04	9.73	34.77	1.13	31.9

SAMPLE : 26 - 13

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
127.3	00.0	.160E-06	037.3	35.4	.215E-06	217.3	54.6	.265E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
1.654	.745	.23	.25	.48	.63	46.2

SAMPLE : 26 - 14

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
079.5	50.5	.380E-06	330.3	15.2	.391E-06	229.1	35.4	.555E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
1.461	.972	.40	.03	.42	1.76	14.5

CORE 29

SAMPLE : 29 - 1

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
033.6	21.9	.400E-06	288.4	32.2	.670E-06	150.8	48.5	.805E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
2.013	.597	.19	.38	.57	.40	54.7

SAMPLE : 29 - 2

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
178.3	62.6	.207E-06	059.1	14.1	.352E-06	322.9	23.0	.509E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
2.456	.589	.57	.53	1.10	.71	43.8

SAMPLE : 29 - 3

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
012.0	28.0	.477E-06	250.6	44.4	.638E-06	121.9	32.5	.677E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
1.420	.747	.07	.27	.34	.21	63.9

SAMPLE : 29 - 4

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
224.9	64.1	.548E-06	335.9	09.9	.654E-06	070.3	23.7	.713E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
1.301	.838	.10	.18	.28	.44	53.2

SAMPLE : 29 - 5

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
253.7	78.2	.254E-06	000.4	03.4	.399E-06	091.1	11.3	.463E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
1.818	.637	.17	.39	.56	.36	56.5

SAMPLE : 29 - 6

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
055.2	20.4	.307E-07	309.7	35.6	.187E-06	168.9	47.3	.222E-05

A/B	C/B	LIN	FOL	ANIS	Q	V
72.208	.164	2.47	.19	2.66	1.73	15.5

SAMPLE : 29 - 7

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
025.6	23.7	.459E-06	274.2	39.9	.550E-06	137.8	40.5	.669E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
1.458	.834	.20	.15	.35	.79	41.2

SAMPLE : 29 - 8

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
246.8	70.6	.583E-07	045.2	17.9	.441E-06	137.0	06.7	.897E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
15.396	.132	1.14	.96	2.11	.75	42.5

SAMPLE : 29 - 9

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
204.1	22.3	.102E-06	078.4	55.1	.144E-06	305.3	25.5	.547E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
5.338	.709	3.62	.38	4.00	1.65	17.9

SAMPLE : 29 - 10

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
220.8	26.5	.188E-06	049.6	63.?	.227E-06	312.5	03.5	.441E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
2.340	.829	.73	.13	.86	1.47	23.1

SAMPLE : 29 - 11

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
029.3	00.1	.197E-07	119.3	25.9	.379E-06	299.1	64.1	.537E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
27.288	.052	.35	.81	1.16	.36	56.5

SAMPLE : 29 - 12

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
191.2	52.9	.123E-06	007.5	37.1	.340E-06	099.2	02.2	.406E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
3.298	.362	.28	.93	1.21	.26	61.2

CORE 30

SAMPLE : 30- 1

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
100.6	46.6	.467E-06	326.4	33.4	.621E-06	219.2	24.3	.954E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
2.041	.752	.57	.27	.84	1.04	34.2

SAMPLE : 30- 2

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
252.8	71.4	.221E-06	042.4	16.2	.468E-06	135.0	08.9	.603E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
2.734	.472	.47	.86	1.33	.43	53.5

SAMPLE : 30- 3

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
065.2	41.1	.409E-06	192.3	34.5	.463E-06	305.4	29.7	.794E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
1.941	.885	.56	.09	.65	1.51	21.9

SAMPLE : 30- 4

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
171.2	80.5	.370E-06	008.7	09.0	.503E-06	278.0	02.8	.623E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
1.682	.736	.32	.35	.67	.62	46.4

SAMPLE : 30- 5

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
167.3	43.1	.417E-06	062.0	15.7	.473E-06	316.9	42.8	.592E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
1.420	.882	.24	.11	.35	1.04	34.3

SAMPLE : 30- 6

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
298.7	39.7	.465E-0	111.6	50.1	.295E-06	205.8	03.5	.324E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
6.973	.158	.16	1.33	1.48	.11	71.0

SAMPLE : 30- 7

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
135.2	38.9	.191E-06	031.6	16.1	.415E-06	283.4	46.6	.475E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
2.484	.461	.20	.73	.93	.24	62.6

SAMPLE : 30- 8

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
265.7	30.9	.887E-08	121.1	53.7	.217E-06	006.3	17.1	.351E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
39.529	.041	.46	.71	1.17	.49	51.3

SAMPLE : 30- 9

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
342.4	80.1	.286E-06	180.0	09.5	.427E-06	089.6	02.9	.523E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
1.830	.670	.31	.45	.76	.51	50.4

SAMPLE : 30- 10

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
162.7	45.6	.187E-07	349.9	44.2	.193E-06	256.4	03.6	.284E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
15.134	.097	.81	1.55	2.36	.41	54.1

SAMPLE : 30- 11

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
104.0	70.0	.191E-07	233.5	13.0	.194E-06	327.0	14.9	.353E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
18.453	.099	.71	.78	1.49	.63	46.4

SAMPLE : 30- 12

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
318.1	28.8	.485E-06	124.6	60.6	.660E-06	224.9	05.7	.445E-05

A/B	C/B	LIN	FOL	ANIS	Q	V
9.192	.734	19.42	.90	20.32	1.83	12.1

SAMPLE : 30- 13

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
253.0	27.5	.111E-06	131.7	44.7	.189E-06	002.5	32.7	.390E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
3.500	.591	.60	.23	.83	1.13	31.8

SAMPLE : 30- 14

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
248.6	62.0	.482E-07	036.7	24.2	.186E-06	132.7	13.1	.329E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
6.827	.260	3.20	3.07	6.27	.69	44.4

CORE 32

SAMPLE : 32 - 1

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
111.6	04.9	.401E-06	017.9	37.4	.499E-06	207.9	52.3	.543E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
1.356	.802	.09	.21	.30	.36	56.3

SAMPLE : 32 - 2

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
176.8	51.7	.434E-06	293.9	19.8	.648E-06	036.5	31.3	.785E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
1.809	.670	.24	.38	.63	.49	51.3

SAMPLE : 32 - 3

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
066.1	56.9	.201E-07	182.3	15.9	.315E-06	281.1	28.1	.389E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
19.369	.064	.71	2.86	3.57	.22	63.5

SAMPLE : 32 - 4

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
315.8	06.6	.154E-06	206.4	70.7	.224E-06	048.0	17.9	.511E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
3.326	.685	1.28	.32	1.60	1.34	26.4

SAMPLE : 32 - 5

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
269.1	38.4	.211E-07	002.8	04.7	.253E-06	098.6	51.2	.267E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
12.621	.083	.05	.85	.90	.06	76.5

SAMPLE : 32 - 6

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
321.4	38.9	.100E-06	065.8	17.3	.186E-06	174.6	46.0	.329E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
3.286	.537	.70	.42	1.12	.91	37.9

SAMPLE : 32 - 7

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
135.7	29.0	.182E-06	251.7	38.2	.235E-06	019.9	38.2	.411E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
2.260	.773	.52	.16	.67	1.24	28.9

SAMPLE : 32 - 8

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
126.9	22.5	.167E-06	298.8	67.3	.291E-06	035.8	02.9	.392E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
2.350	.572	.35	.44	.79	.57	48.1

SAMPLE : 32 - 9

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
048.9	18.8	.743E-07	153.8	36.9	.262E-06	297.5	47.0	.284E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
3.822	.284	.07	.63	.70	.11	71.1

SAMPLE : 32 - 10

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
068.8	05.2	.268E-06	333.9	36.0	.324E-06	165.8	53.3	.365E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
1.363	.827	.13	.17	.30	.54	49.4

SAMPLE : 32 - 11

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
061.1	04.1	.130E-06	154.2	37.7	.190E-06	325.9	51.9	.256E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
1.977	.681	.26	.24	.50	.70	43.8

SAMPLE : 32 - 12

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
118.1	15.9	.610E-07	026.2	07.0	.733E-07	273.9	72.6	.110E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
1.804	.832	.44	.15	.59	1.20	30.0

SAMPLE : 32 - 13

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
334.1	66.8	.245E-08	084.0	08.3	.455E-07	177.3	21.5	.223E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
91.214	.054	2.06	.50	2.56	1.35	26.2

SAMPLE : 32 - 14

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
116.9	36.0	.199E-07	305.6	53.7	.953E-07	210.0	04.1	.154E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
7.738	.209	.45	.57	1.02	.56	48.5

CORE 32 (Cont'd)

SAMPLE : 32 - 15

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
026.2	30.8	.328E-07	215.5	58.9	.111E-06	118.6	04.1	.418E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
12.735	.296	7.73	1.96	9.69	1.33	26.8

SAMPLE : 32 - 16

DEC1	INC1	MAG1	DEC2	INC2	MAG2	DEC3	INC3	MAG3
226.9	34.6	.182E-07	000.9	45.3	.719E-07	118.5	24.6	.106E-06

A/B	C/B	LIN	FOL	ANIS	Q	V
5.844	.253	.52	.81	1.33	.49	51.3